10

ECG

"ECG Display"

52b

IN/OUT of MRI

80

50a

52a

50b

60

QRS Complex
Processor

threshold

20

QRS Complex
Template

55

55   52a   60

50a   50b

CORRELATION

TRIGGER

85

80

MRI System

#NMR#

55

EGG

10

60'
REAL TIME
CORRELATION

50'a   50'b

High ↑

Threshold Value
(when QRS Complex
Template supercedes
these sections of the Real Time
Signal)

FiG. 1

INVENTOR: Leon Axel
TITLE: METHOD OF USING A MATCHED FILTER FOR
DETECTING QRS COMPLEX FROM A PATIENT UNDERGOING
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FIG. 2

START

RECEIVING AN ECG
SIGNAL FROM A
PATIENT — 212

RECORDING THE ECG SIGNAL — 214

IDENTIFYING EACH SHAPE IN
TIME UNIQUE TO QRS COMPLEX — 216

DETERMINING A QRS COMPLEX
TEMPLATE — 218

CORRELATING QRS COMPLEX TEMPLATE
WITH A CONTINUOUS IN TIME ECG SIGNAL
SAMPLE — 222

DETERMINE
THRESHOLD — 224

RECEIVING A REAL
TIME ECG SIGNAL — 226

CORRELATING QRS COMPLEX
TEMPLATE WITH REAL TIME ECG
SIGNAL — 228

NO

DOES REAL TIME ECG
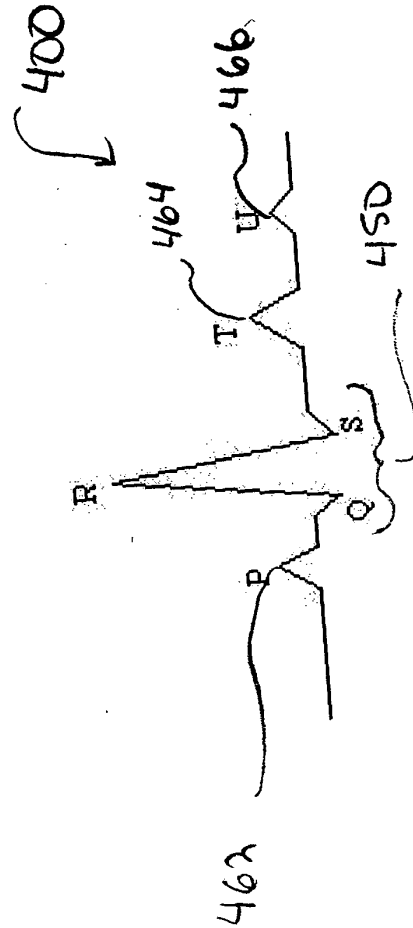SIGNAL EXCEED
THRESHOLD? — 232

YES

INTIATE TYPE OF MRI DATA
AQUISITION — 234
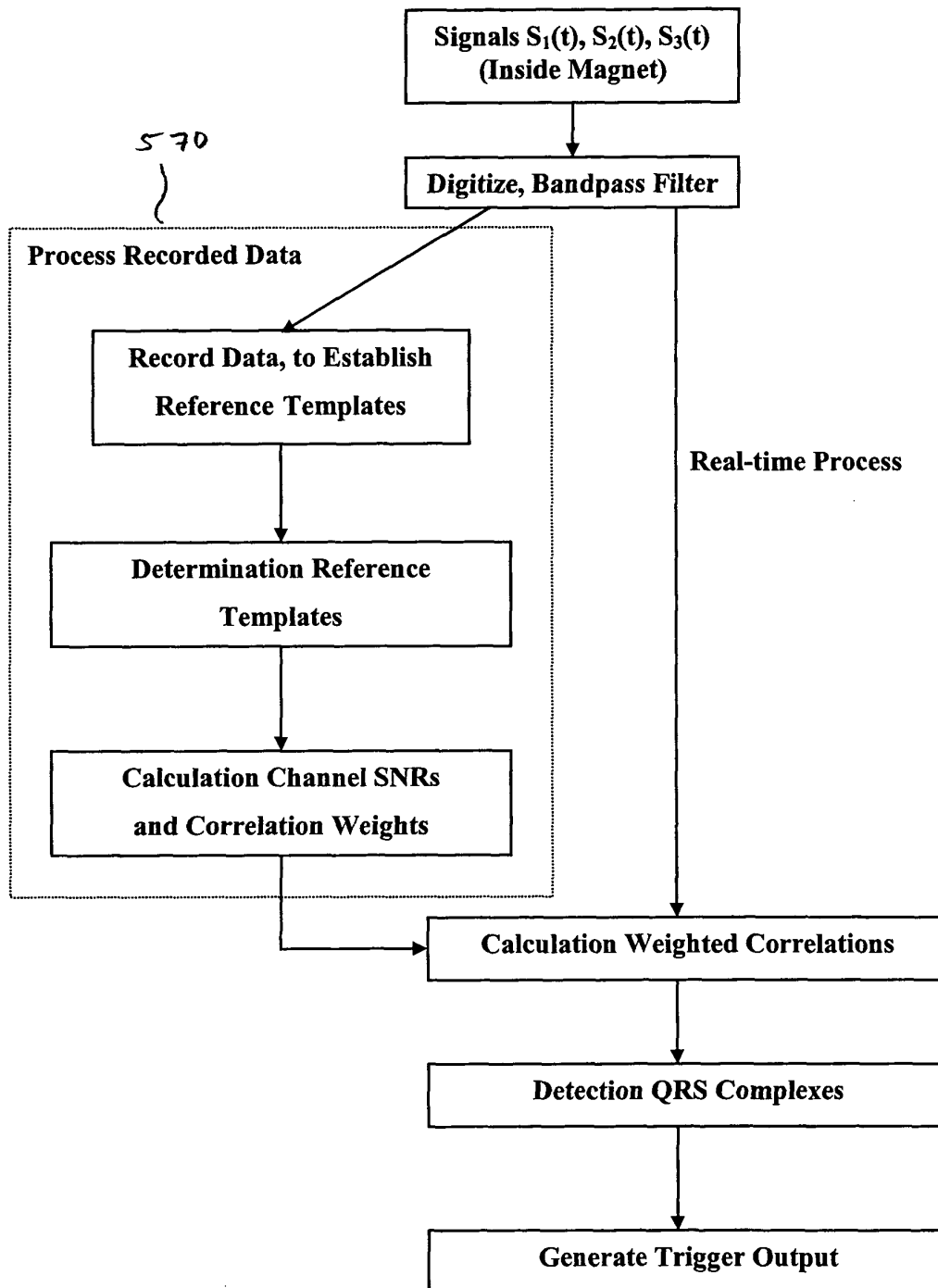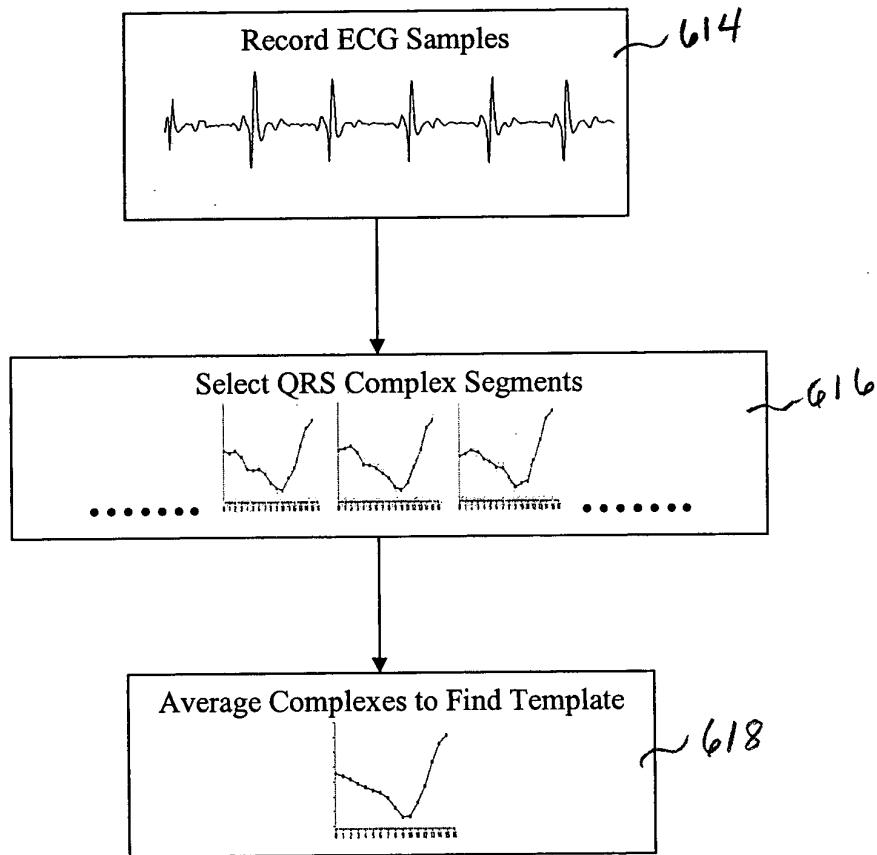
END

INVENTOR: Leon Axel
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FIG. 3

START

RECEIVING A SET OF ECG SIGNALS FROM A PATIENT — 312

RECORDING THE ECG SIGNALS — 314

IDENTIFYING EACH SHAPE IN TIME UNIQUE TO QRS COMPLEX — 316

IDENTIFY WINDOW OF TIME — 317

DETERMINING A QRS COMPLEX TEMPLATE — 318

CORRELATING QRS COMPLEX TEMPLATE WITH A CONTINUOUS IN TIME ECG SIGNAL SAMPLE — 322

DETERMINING WEIGHTED SCORE FOR EACH CHANNEL — 323

DETERMINE THRESHOLD FOR COMBINED CHANNELS BASED ON WEIGHTED SCORE FOR EACH CHANNEL — 324

RECEIVING A REAL TIME ECG SIGNAL — 326

CORRELATING QRS COMPLEX TEMPLATE WITH REAL TIME ECG SIGNAL — 328

COMBINING CORRELATION FOR EACH CHANNEL — 329

DOES REAL TIME ECG SIGNAL EXCEED THRESHOLD? — 332

NO

YES

INITIATING TYPE OF MRI DATA ACQUISITION — 334

END

INVENTOR: Leon Axel
TITLE: METHOD OF USING A MATCHED FILTER FOR DETECTING QRS COMPLEX FROM A PATIENT UNDERGOING MAGNETIC RESONANCE IMAGING
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FIG.4

INVENTOR: Leon Axel
TITLE: METHOD OF USING A MATCHED FILTER FOR
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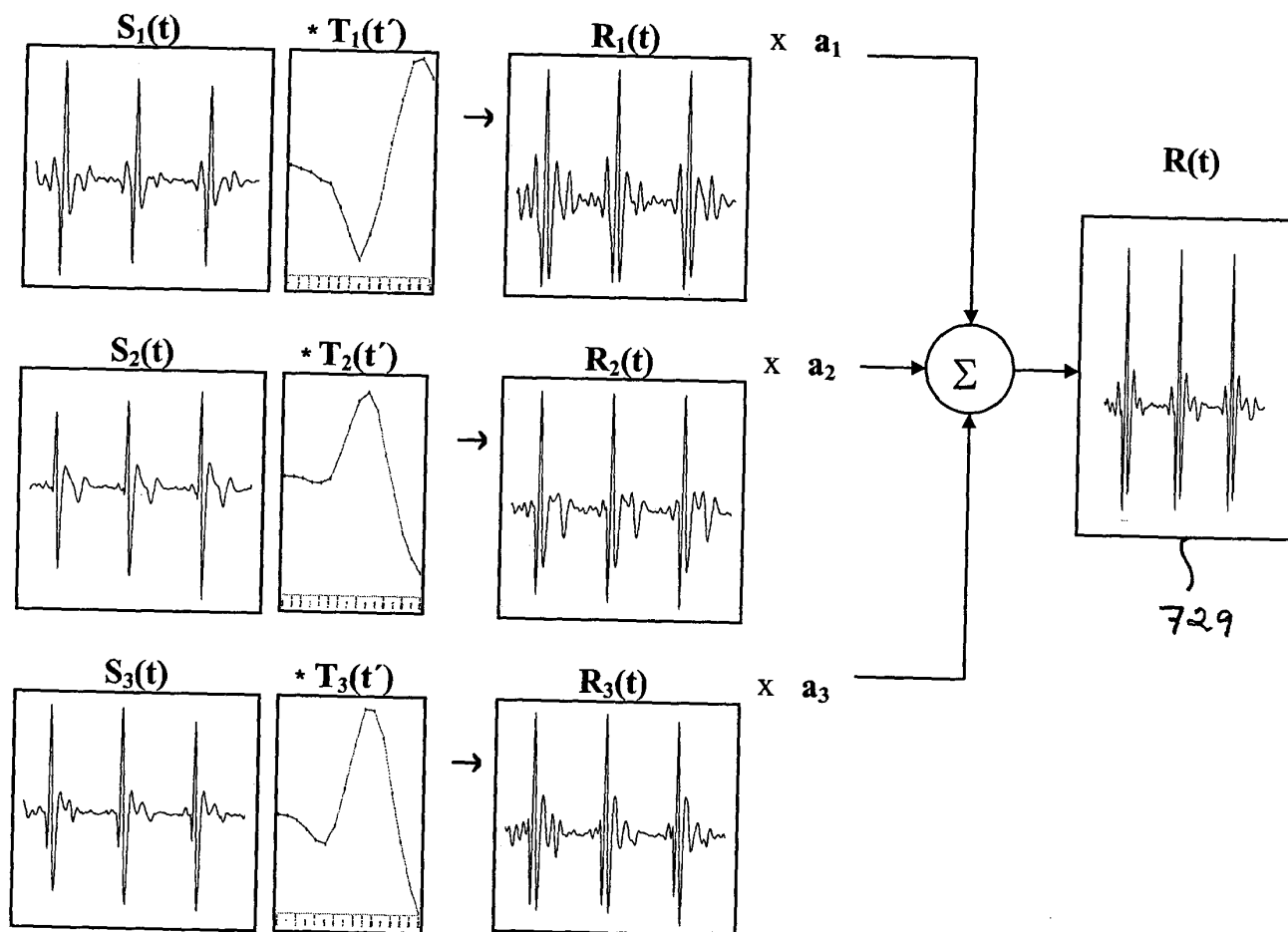
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Figure 5

Signals $S_1(t)$, $S_2(t)$, $S_3(t)$
(Inside Magnet)

570

Digitize, Bandpass Filter

Process Recorded Data

Record Data, to Establish
Reference Templates

Real-time Process

Determination Reference
Templates

Calculation Channel SNRs
and Correlation Weights

Calculation Weighted Correlations

Detection QRS Complexes

Generate Trigger Output

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MAGNETIC RESONANCE IMAGING
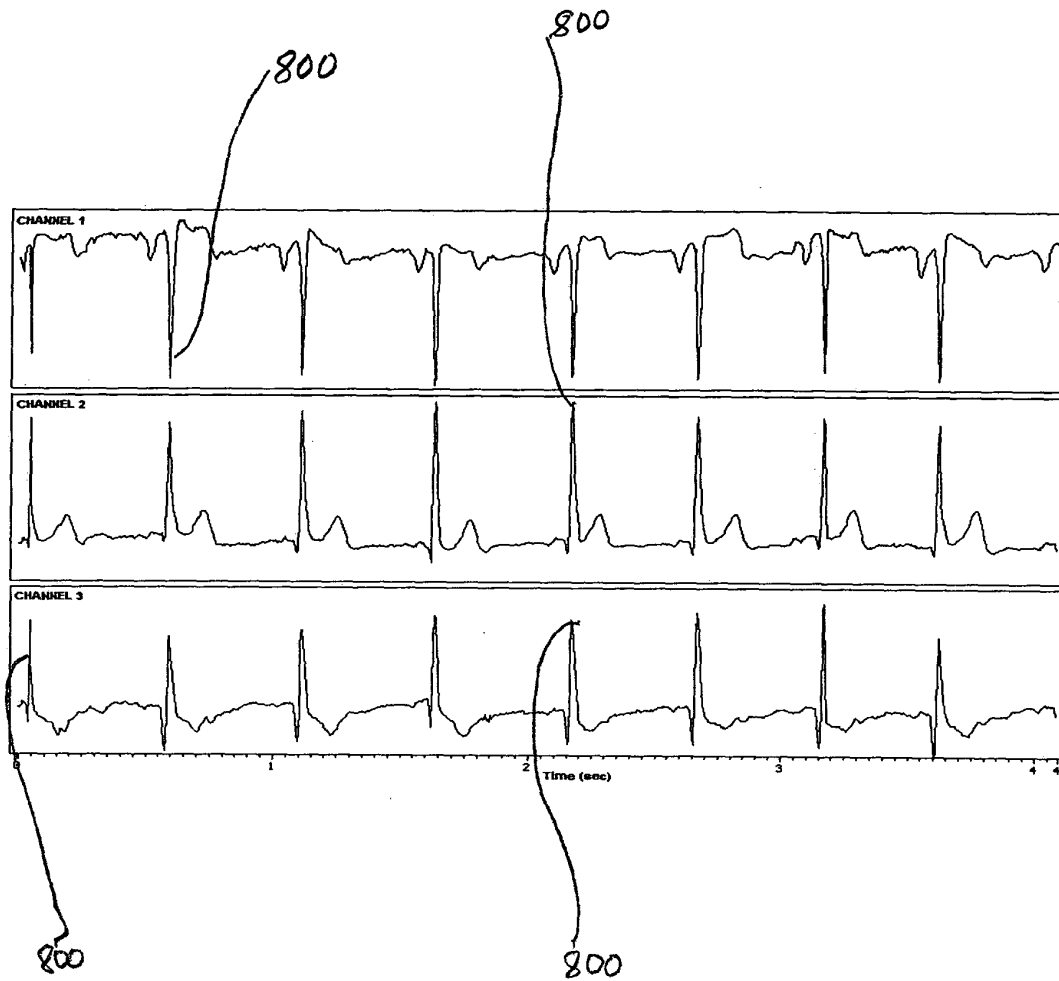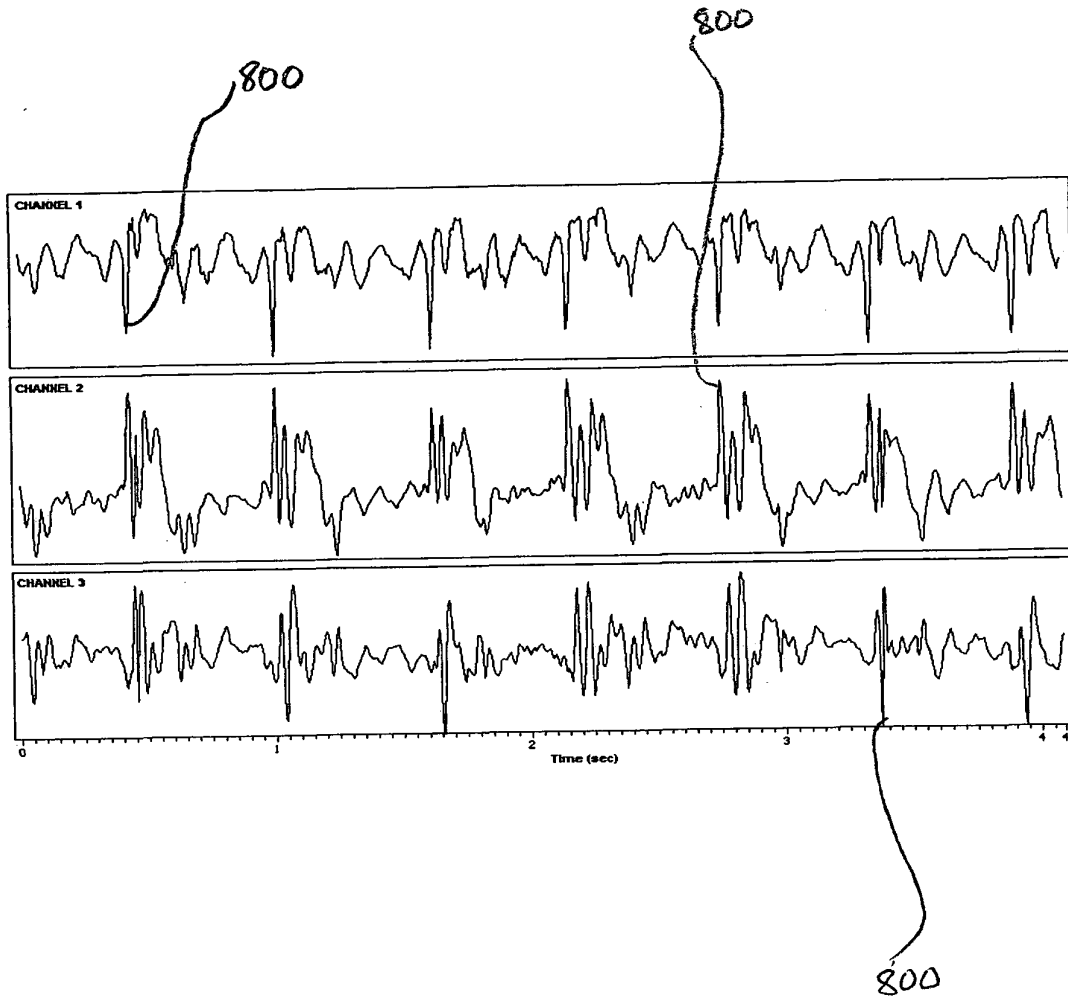Docket No.: 5986/1K435 US1

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Figure 6

Figure 7

INVENTOR: Leon Axel
TITLE: METHOD OF USING A MATCHED FILTER FOR
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$S_1(t)$ $\ast\,T_1(t')$ $R_1(t)$ x a_1

$S_2(t)$ $\ast\,T_2(t')$ $R_2(t)$ x a_2

$S_3(t)$ $\ast\,T_3(t')$ $R_3(t)$ x a_3

Σ

$R(t)$

729

INVENTOR: Leon Axel
TITLE: METHOD OF USING A MATCHED FILTER FOR
DETECTING QRS COMPLEX FROM A PATIENT UNDERGOING
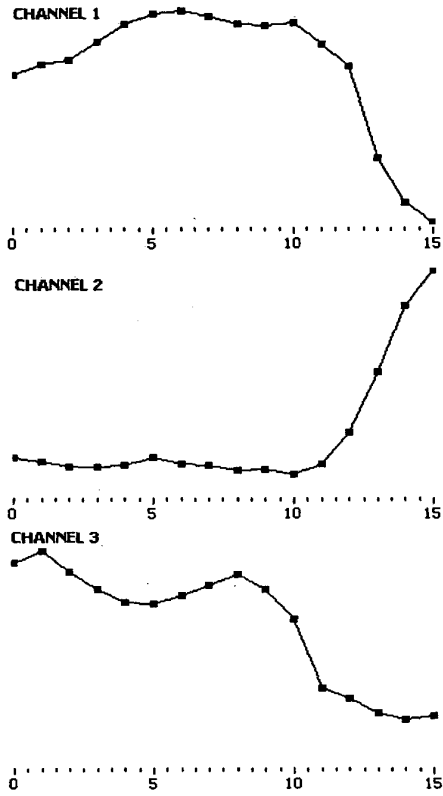MAGNETIC RESONANCE IMAGING
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Figure 8A

INVENTOR: Leon Axel
TITLE: METHOD OF USING A MATCHED FILTER FOR
DETECTING QRS COMPLEX FROM A PATIENT UNDERGOING
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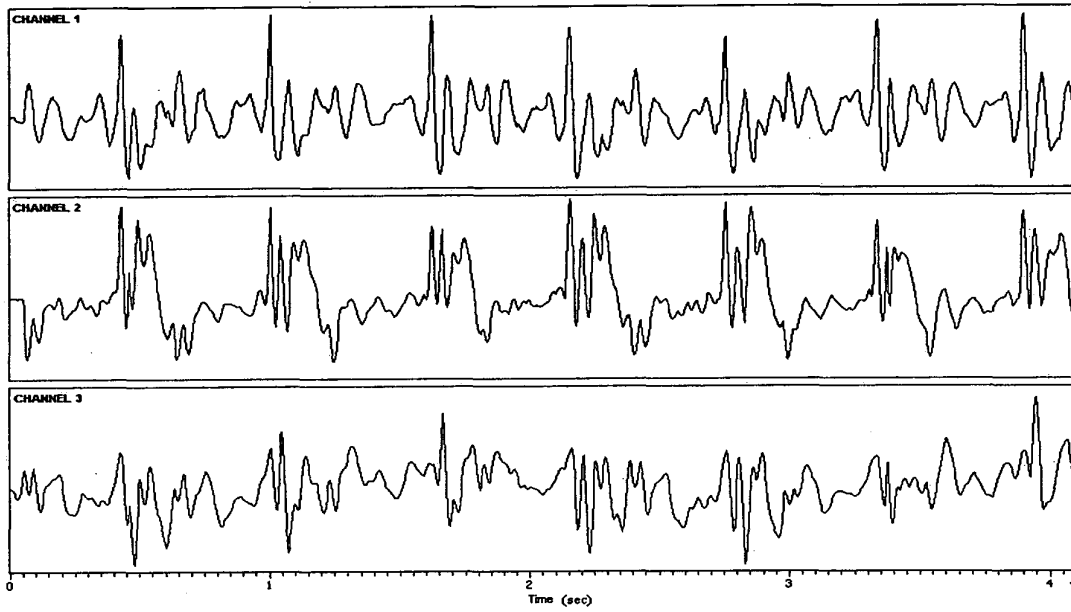Docket No.: 5986/1K435 US1

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Figure 8B

INVENTOR: Leon Axel
TITLE: METHOD OF USING A MATCHED FILTER FOR
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Figure 9

CHANNEL 1

0   5   10   15

CHANNEL 2

0   5   10   15

CHANNEL 3

0   5   10   15

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Figure 10

Figure 11

INVENTOR: Leon Axel
TITLE: METHOD OF USING A MATCHED FILTER FOR
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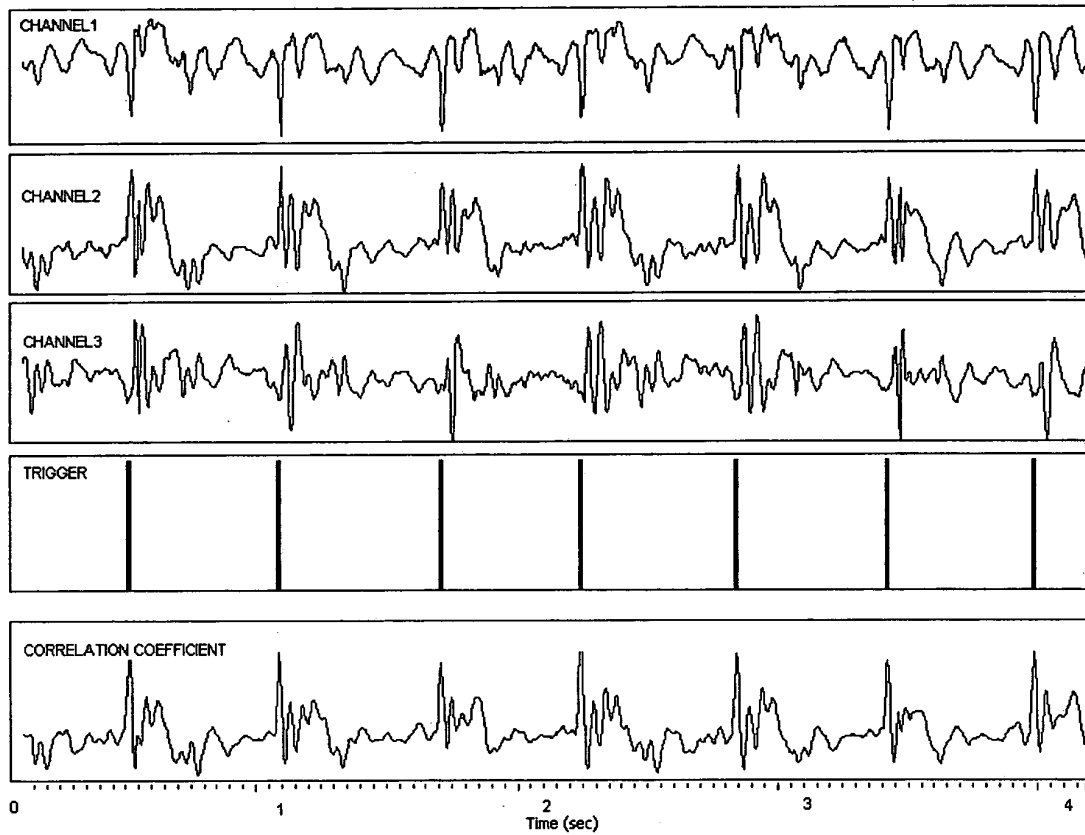Docket No.: 5986/1K435 US1

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INVENTOR: Leon Axel
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Figure 12